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PROVISIONAL INTELLIGENCE REPORT

USE PATTERN FOR ABRASIVE GRAIN IN THE USSR

CIA/RR PR-103-S-1

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USE PATTERN FOR ABRASIVE GRAIN IN THE USSR

CIA/RR PR-103-S-1

(ORR Project 34.1016)

NOTICE

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FOREWORD

This report on the use pattern of crude abrasives in the USSR is a supplement to CIA/RR PR-103, The Abrasives Industry in the USSR, 25 March 1955, SECRET/NOFORN.

The use pattern discussed in this report is that of artificial abrasives -- primarily silicon carbide and aluminum oxide -- and of the natural abrasives emery and corundum. Other natural abrasives are excluded.

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CIA/RR PR-103-S-1
(ORR Project 34.1016)

USE PATTERN FOR ABRASIVE GRAIN IN THE USSR*

Summary

Soviet production of abrasive grain in 1953 was estimated at 103,000 metric tons,** and imports were estimated at 7,800 tons. After allowances were made for the portion of production of abrasive grain required by nonabrasive uses and for a weight-loss factor, it was estimated that in 1953, 88,500 tons of abrasive grain reached the various consumers of abrasive products.

Abrasives are used in many industries and in all economic regions*** of the USSR, but 3 industries, located primarily in 4 economic regions, use the major portion. Based on usage in 1953, approximately 67 percent of the total supply of abrasive grain is used by producers of transport equipment, machinery, and metallurgical products. Geographically, Economic Regions I, III, VII, and VIII accounted for almost 70 percent of the abrasive grain used for abrasive purposes.

Region VII has no local supplies of crude abrasives but is a major consumer. No production of crude abrasives is foreseen in this region, however, because of problems in the supply of raw materials.

It would be economically feasible for the USSR to begin production of crude silicon carbide in the Urals and of crude aluminum oxide in the Ukraine. Both of these areas are major consumers of abrasives, but the Ukraine produces only silicon carbide, and the Urals only aluminum oxide.

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* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 July 1956.

** Tonnages throughout this report are given in metric tons.

*** The term region in this report refers to the economic regions defined and numbered on CIA Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955, except that the following regions have been combined: Ia and Ib as I, IIa and IIb as II, and Xa and Xb as X.

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I. Introduction.

Crude artificial abrasives, primarily aluminum oxide and silicon carbide, are produced in four plants in the USSR. These plants are located in Leningrad, Zaporozh'ye, Chelyabinsk, and Tashkent. After the crude artificial abrasives have been made, they are crushed and screened to produce abrasive grain, which is shipped to various plants producing finished products or is processed further in another part of the crude abrasive plant. Finished products -- such as bonded abrasive wheels, coated abrasive products, and grinding powders -- and nonabrasive products -- such as refractories and resistors -- are then produced.* Nonabrasive uses consume approximately 13 percent of the total domestic production of abrasive grain. In addition, an estimated weight-loss factor of 1.1 tons of abrasive grain to 1 ton of finished product must be applied to the remaining 87 percent of domestic production and to estimated Soviet imports of abrasive grain. Soviet production of abrasive grain in 1953 was estimated at 103,000 tons and imports were estimated at 7,800 tons. Thus, out of the 110,800 tons of abrasive grain produced and imported in 1953, only 88,500 tons reached the various consumers of abrasive products.** Because the natural abrasives emery and corundum represent a small proportion of the total production of abrasives, the loss factors for artificial abrasives were used for natural abrasives.

The estimated pattern of distribution of the 88,500 tons of abrasive grain to Soviet industrial sectors and economic regions was based on the use patterns for abrasive grain in the US and the UK, adjusted to reflect the differing emphasis in the Soviet economy.*** A percentage use pattern for each economic region was computed by applying an estimated percentage distribution of production by economic region in each industrial sector.****

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* For estimates of total production and more detailed information on the technology of the abrasives industry, see source 1/. (For serially numbered source references, see Appendix C.)

** See Appendix A, Section 2.

*** See Appendix A, Section 3.

**** See Appendix A, Section 4.

II. Use by Industrial Sector.

Table 1 shows the estimated use pattern for abrasive grain in the USSR in 1953, by industrial sector, in percentage of total use and in absolute amounts. 2/ Three industrial sectors -- transport equipment, machinery, and metallurgy -- used slightly more than 66 percent of the total supply of abrasive grain in 1953. Another 10 percent was used in production of ordnance and antifriction bearings. The remainder was used by the producers of furniture, optical equipment, special machinery, agricultural equipment, and other products.

Table 1

Estimated Use Pattern for Abrasive Grain in the USSR, by Industrial Sector 1953

Industrial Sector	Percent of Total	Metric Tons	Margin of Error a/* (Percent)
Transport equipment	30	26,500	±20
Aircraft and accessories Locomotives and railroad equipment Motor vehicles Shipbuilding			
Machinery	20	17,700	±25
Machine tools Metalforming machinery Cutting tools Machinery accessories			
Metallurgy	17	15,000	±25
Finished steel Cast iron Forging			

* Footnote for Table 1 follows on p. 5.

Table 1

Estimated Use Pattern for Abrasive Grain
in the USSR, by Industrial Sector
1953
(Continued)

Industrial Sector	Percent of Total	Metric Tons	Margin of Error a/ (Percent)
Ordnance	5	4,400	±30
Antifriction bearings	5	4,400	±30
Woodworking	4	3,500	±30
Furniture			
Sawmilling			
Pulp and paper			
Optical equipment	3	2,700	±30
Lenses for field glasses, microscopes, cameras, and the like			
Other			
Agricultural equipment	3	2,700	±30
Special machinery	2	1,800	±30
Textile			
Printing			
Woodworking			
Other			
Leather	2	1,800	±30
Shoemaking			
Other			

Table 1

Estimated Use Pattern for Abrasive Grain
in the USSR, by Industrial Sector
1953
(Continued)

Industrial Sector	Percent of Total	Metric Tons	Margin of Error a/ (Percent)
Electronic and electrical equipment	1	900	±30
Mining equipment	1	900	±30
Miscellaneous	7	6,200	±30
Engines and turbines			
Construction equipment			
Hardware			
Custom machines			
Total	100	88,500	±20

a. The estimate may encompass one standard error. If the various errors implicit in the estimates are taken into account, the probability is about 2 to 1 that actual use will fall within the limits specified above.

III. Use by Economic Region.

Table 2* shows the estimated use pattern for abrasive grain in the USSR in 1953 in metric tons, by industrial sector and by economic region. 3/ Table 3** shows the estimated use pattern for abrasive grain in the USSR in 1953 as a percentage of total consumption, also by industrial sector and by economic region. 4/ Regions I, III, VII, and VIII accounted for almost 70 percent of the abrasive grain used for abrasive purposes.***

* Table 2 follows on p. 6.
** Table 3 follows on p. 7.
*** Continued on p. 8.

Table 2

Estimated Use Pattern for Abrasive Grain in the USSR, in Metric Tons, by Industrial Sector and by Economic Region
1953

Metric Tons

Industrial Sector	Economic Region											
	I a/	II b/	III	IV	V	VI	VII	VIII	IX	X c/	XI	XII
Transport equipment	3,800	1,200	3,700	1,400	700	2,400	7,500	1,400	1,300	300	1,000	1,800
Machinery d/	1,800	1,900	2,400	200	700	1,000	7,500	1,600	300	200	100	e/
Metallurgy	300		5,800	300	300	400	900	5,400	1,200	100	200	100
Ordnance	200		300	300		600	500	1,100	800	400	200	
Antifriction bearings			200			1,100	2,700	100	300			
Woodworking	300	400	200	200		700	1,400	100	100		100	
Optical equipment	700		200	•		200	600	400	600			
Agricultural equipment	100	200	700	500		200	400	200	200	200		
Special machinery	300		300	100			1,000			100		
Leather		100	300	200	100	200	700		100	100		
Electronic and electrical equipment	200		200	100	100		200	100				
Mining equipment f/			400				400	100				
Miscellaneous	400	600	500			500	1,600	1,900	500	200		
Total g/	8,100	4,400	15,300	3,300	1,900	7,300	25,400	12,400	5,400	1,500	1,500	1,900
Margin of error (percent) h/	±25	±30	±25	±30	±30	±30	±20	±25	±30	±30	±30	±30

a. Includes Ia and Ib.
b. Includes IIa and IIb.
c. Includes Xa and Xb.
d. The use pattern shown for the machinery industry is for 1954.
e. The absence of a figure indicates a negligible quantity.
f. The use pattern shown for the mining equipment industry is for 1952.
g. Totals may not add because of rounding.
h. The margin of error applies only to the regional totals. In any particular region the errors implicit in estimating (1) total production and imports of abrasive grain in the USSR, (2) the use of abrasives by industrial sector, and (3) the distribution of those sectors may multiply to give a use figure differing substantially from the estimates shown above. It is believed probable, however, that the actual use in each region falls within the limits specified.

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Table 3

Estimated Use Pattern for Abrasive Grain in the USSR, as Percentage of Total Consumption, by Industrial Sector and by Economic Region 1953

Percent

Industrial Sector	Economic Region											
	I a/	II b/	III	IV	V	VI	VII	VIII	IX	X c/	XI	XII
Transport equipment	4.3	1.4	4.2	1.6	0.8	2.6	8.5	1.6	1.5	0.3	1.1	2.1
Machinery d/	2.0	2.2	2.7	0.2	0.8	1.1	8.5	1.8	0.4	0.2	0.1	e/
Metallurgy	0.4		6.6	0.4	0.3	0.5	1.0	6.1	1.3	0.1	0.2	0.1
Ordnance	0.2		0.4	0.3		0.7	0.6	1.2	0.9	0.5	0.2	
Antifriction bearings			0.3			1.3	3.0	0.1	0.3			
Woodworking	0.4	0.4	0.2	0.2		0.8	1.6	0.2	0.1		0.1	
Optical equipment	0.8		0.2			0.2	0.7	0.4	0.7			
Agricultural equipment	0.1	0.2	0.8	0.6		0.2	0.5	0.2	0.2	0.2		
Special machinery	0.4		0.3	0.1			1.1			0.1		
Leather		0.1	0.3	0.2	0.1	0.3	0.8		0.1	0.1		
Electronic and electrical equipment	0.3		0.2	0.1	0.1		0.2	0.1				
Mining equipment f/			0.5				0.4	0.1				
Miscellaneous	0.3	0.7	0.6			0.6	1.8	2.2	0.6	0.2		
Total	9.2	5.0	17.3	3.7	2.1	8.3	28.7	14.0	6.1	1.7	1.7	2.2
Margin of error (percent) g/	±25	±30	±25	±30	±30	±30	±20	±25	±30	±30	±30	±30

a. Includes Ia and Ib.
b. Includes IIa and IIb.
c. Includes Xa and Xb.
d. The use pattern shown for the machinery industry is for 1954.
e. The absence of a figure indicates a negligible quantity.
f. The use pattern shown for the mining equipment industry is for 1952.
g. The margin of error applies only to the regional totals. In any particular region the errors implicit in estimating (1) total production and imports of abrasive grain in the USSR, (2) the use of abrasives by industrial sector, and (3) the distribution of those sectors may multiply to give a use figure differing substantially from the estimates shown above. It is believed probable, however, that the actual use in each region falls within the limits specified.

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IV. Possible Developments.

Tables 2 and 3 emphasize two interesting locational problems in the crude abrasives industry of the USSR. The first problem concerns supplies of abrasives for Region VII, which consumes approximately 29 percent of the total supply of abrasive grain. Of the four major consuming regions, Region VII is the only one without a local supply of abrasive grain. Regardless of the regional demand for abrasives, however, it does not appear logical for the USSR to establish production of either crude silicon carbide or crude aluminum oxide in Region VII. The basic raw materials, silica sand or bauxite, would have to be imported into the region by long overland haul, and there is a substantial loss of weight between the raw material inputs and the finished crude abrasives. Manufacture of silicon carbide requires approximately 1.65 tons of silica sand and 1.3 tons of petroleum or pitch coke to produce 1 ton of regular crude abrasives. Approximately 1.95 tons of dry bauxite are required to produce 1 ton of regular aluminum oxide crude abrasives. 5/

Problems inherent in the shipment of the finished product are its breakable nature and the amount of packing required for transport. The loss-weight ratio of abrasive grain to finished product, however, is not great. It therefore appears more logical to ship the abrasive grain rather than the finished product. Because of the problems inherent in developing a center for production of crude abrasives in Region VII, it is probable that abrasive grain will continue to be shipped to the finished products plants at Moscow and Shuya and that a center for producing crude abrasives will not be developed in Region VII.

Another important problem is the disproportion between the production and the needs in Regions III and VIII. Table 4* compares production of and requirements for abrasive grain in both regions. 6/

The disproportion shown in Table 4 is accentuated by the fact that the Zaporozh'ye plant (Region III) produces only silicon carbide, whereas the Chelyabinsk plant (Region VIII) produces only aluminum oxide. It is necessary, therefore, to ship aluminum oxide to the Ukraine (Region III), probably from Leningrad or Chelyabinsk, and silicon carbide to the Urals (Region VIII).

* Table 4 follows on p. 9.

Table 4

Comparison of Production
of and Requirements for Abrasive Grain
in Economic Regions III and VIII of the USSR
1953

Metric Tons

Economic Region	Production a/	Requirement
III	7,600	15,300
VIII	31,400	12,400

a. Estimated production of abrasive grain in each region minus 13 percent destined for non-abrasive products. These figures do not include natural abrasives or a proportionate share of imports. Production of natural corundum and emery totaled 5,500 tons in 1953. 7/

The basic raw materials for the production of the deficit abrasives are readily available in both the Urals and the Ukraine. It would be logical, therefore, for production of crude silicon carbide to begin in the Urals or for production of crude aluminum oxide to begin in the Ukraine. There is insufficient evidence, however, on the priorities assigned to production of crude abrasives with respect to labor and raw materials (bauxite and silica sand) and on other factors to permit a more definite conclusion regarding possible areas where production might be expanded. In addition, it is possible that political or military factors, such as the vulnerability of the Ukraine in case of war, may be the deciding locational factor.

APPENDIX A

METHODOLOGY

1. General.

The estimates of the percentage of crude artificial abrasives used in each industrial sector and economic region of the USSR were computed as follows:

a. An estimate of the percentage of total abrasives used by each industrial sector was made.

b. The estimate of the percentage of abrasives used in each industrial sector was multiplied by the estimated percentage of total production in each region.

c. The percentage and/or the amounts of abrasives used by all industrial sectors within each economic region were totaled to obtain the regionwide figures.

For example, it is estimated that the ordnance sector consumed 5 percent of all abrasive grain used in the USSR in 1953 and that 23.9 percent of production of ordnance was in Region VIII. The ordnance sector in Region VIII therefore used 1.2 percent of all abrasive grain (5 percent x 23.9 percent), or approximately 1,100 tons. By adding the total of the percentage for all industrial sectors in Region VIII, it was found that Region VIII consumed 14 percent of all abrasive grain used in the USSR in 1953.

2. Estimate of Total Abrasive Grain Used for Abrasive Purposes.

The estimate of production of abrasive grain in the USSR in 1953 is 103,000 tons. Only about 87 percent of the total, or 89,600 tons, was used for bonded or coated products and for grinding powders. The remaining 13 percent was used for production of refractories, resistors, and other nonabrasive products. When the estimate of imports of abrasive grain in 1953 -- 7,800 tons -- was added to this adjusted total, a figure of 97,400 tons was computed as the total amount of abrasive grain used for abrasive purposes in 1953.

In general, it requires 1.1 tons of abrasive grain to produce 1 ton of bonded abrasive wheels. It is believed that this loss-weight ratio is also applicable to grinding powders and coated products. To the degree that this assumption is inaccurate, the estimate of the abrasive grain delivered to the consumers will be in error. Any error should be small, however, because bonded products use 75 percent of the total abrasive grain produced, with coated products and grinding powders using only 12 percent.

By applying this ratio of 1.1 to 1, the total amount of abrasive grain used for grinding purposes in 1953 was estimated to be 88,500 tons.

3. Estimates of the Use of Abrasive Grain by Industrial Sector.

The estimates of the use of abrasive grain shown in Table 1* were made on the basis of use patterns for abrasives in the US and the UK, adjusted to account for differences in the emphasis given various industries in the USSR. For example, the estimates of the use of abrasive grain in the Soviet machinery sector and in the ordnance sector are higher than either the US or the UK figures, reflecting the differing emphasis given these two sectors in the Soviet economy.

4. Regional Distribution.

Much of the data on regional distribution was taken from source 8/. In addition, a number of other published reports were used. Some of the estimates of the distribution of production by region were made in terms of value; others were made in terms of weight, floorspace, or units. These patterns of distribution were checked for additions based on more recent data.** In some cases, the regional distribution was given for the products of the industry but not for the entire industry. A weighted average of these distribution figures was computed where the unit of measure was the same for all products. When the unit of measure did not allow aggregation, conversion or weighting factors were obtained. In deriving these factors, two special problems were encountered. First, there was a lack of information on some of the products of a given industry. A sample of the information available was selected which was believed to be representative of regional distribution for the entire industry. The second problem concerned the locomotive and railroad

* P. 3, above.

** Estimates of the regional distribution of production were obtained for the following industries: optical equipment, printing machinery, construction equipment, and furniture.

equipment industry. The various types of equipment employed by this industry require markedly different quantities of abrasives in their production. In this case, two weightings were used. The patterns for regional distribution of the various types of equipment based on units were weighted: first, by an estimate of the crude steel input for each type of equipment and, second, by an estimate of the ratio of abrasives required in production of locomotives to that required in production of railroad cars. This ratio, which was at a rate of 4 to 1, was derived from information about the amount of abrasives used per locomotive and railroad car produced in the US in 1947.

The various industries were aggregated into their respective sectors by two methods. Under the first method, because of the lack of information regarding the percentage distribution for certain industries within an industrial sector, it was assumed that the percentage distribution for the known industries was representative of the distribution for the whole sector. The most important sectors involving this assumption are machinery and metallurgy. The distribution for the machinery sector was assumed to be equal to that for the machine tool industry because of lack of information about the metalforming, cutting tool, and machinery accessories industries. Similarly, the pattern of distribution for the metallurgical sector was assumed to approximate that for the finished steel industry because the distribution for cast iron foundries and forging shops cannot be separated from the distribution for the entire industry. In addition to a few specialized foundries, there are a large number of small forging shops scattered throughout the USSR, and most medium and large plants have foundries. Although there is some error implicit in this assumption, it should be relatively small because machine tools and finished steel account for a large share of the abrasives used in their respective sectors.

In aggregating the industry percentages in sectors containing more than one industry, the following method was employed. In the case of the special-machinery sector, an unweighted average of the regional distribution figures was computed. In the transport equipment sector, the various industries were weighted by number of employed workers on the assumption that the use of abrasives per worker is somewhat comparable in the four industries. Consumption of finished steel and aluminum or the number and size of grinding machines in each industry probably would have been a more accurate weight. The number of workers, however, probably is the best weight available.

APPENDIX B

GAPS IN INTELLIGENCE

The gaps in intelligence cited in CIA/RR PR-103, The Abrasives Industry in the USSR, 25 March 1955, SECRET/NOFORN, also apply to this report.

In addition, information on the regional distribution of production in the metalforming machinery, the pulp and paper, and other major industries using abrasives would have contributed to the accuracy of the use pattern of abrasive grain estimated in this report.

APPENDIX C

SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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1. CIA. CIA/RR PR-103, The Abrasives Industry in the USSR, 25 Mar 55. S/NOFORN.

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2. [redacted]

3. CIA. CIA/RR IP-361, Soviet Capabilities and Probable Soviet Courses of Action Through Mid-1956, 30 Apr 54, Appendix B, p. 68-73. S.
   CIA. CIA/RR 50, The Aircraft Industry of the USSR, 5 Jan 55, p. 56-58, info 15 Sep 54. S.
   CIA. CIA/RR 47, The Machine Tool Industry in the USSR, 22 Nov 54, p. 10, info 30 Jun 54. S/US ONLY.
   CIA. CIA/RR 48, Production of Agricultural Machinery in the USSR, 5 Jan 55, Table 18, p. 72-82. S/US ONLY.
   CIA. CIA/RR 21, The Coal Mining Equipment Industry of the USSR, 27 May 53, Table 20, p. 122-125. S.
   CIA. CIA/RR PR-100, The Production of Diesel and Oil Engines in the USSR, 12 Feb 55, Table V, p. 21. S.
4. Ibid.
5. CIA. CIA/RR PR-103 (1, above), p. 18-19. S/NOFORN.
6. Ibid., Table 2, p. 9. S/NOFORN.
7. Ibid.
8. CIA. CIA/RR IP-361 (3, above).

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